

A Backward Regressed Capsule Neural Network for Plant Leaf Disease Classification

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Abstract

This study investigated the introduction of backward regression coupled with DenseNet features into a Capsule Neural Network (CapsNet) for plant leaf disease classification. Plant diseases are considered one of the main factors influencing food production, and therefore fast crop diseases detection and recognition is important in enhancing interventions. In the recent past, CapsNets have been used for plant leaf disease classification with some success. However, back propagation of signals to earlier layers is still a challenge due to low gradient flow, parameter and computational complexities exist due to lack of feature diversification which leads to poor patterns, and uses only higher level features while all features are necessary for classification. This work therefore adopted DenseNet intuition where a loop connectivity pattern was done in the convolution layer, a technique that made it easier for signals to be back propagated and create a strong gradient flow. The resultant model was able to attain computational and parameter efficiency because feature diversification led to richer patterns hence higher accuracy. The resultant model maintained low complexity as it used both complex and simple features. After feature collected in the convolution layer, backward regression was introduced to select only the features that had significant information to be used by the model, a technique that reduced

computation time and reduced characters in the model without the loss of data. This work used the standard PlantVillage (PV) dataset comprising of ten tomato classes with a total of 9080 images and observed 99% accuracy on testing with backward regression and 87% on testing without backward regression.

Keywords: DenseNet, Plant Leaf, Convolutional Neural Network, Capsule Neural Network, Model Training, Deep Learning

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